ART AS A VEHICLE FOR DEVELOPING CREATIVE THINKING
THROUGH RIGHT HEMISPHERE INFORMATION PROCESSING

by

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A Thesis Submitted to the Faculty of the
DEPARTMENT OF ART
In Partial Fulfillment of the Requirements
For the Degree of
MASTER OF ARTS
WITH A MAJOR IN ART EDUCATION

In the Graduate College
THE UNIVERSITY OF ARIZONA

1980
STATEMENT BY AUTHOR

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ACKNOWLEDGMENTS

I express my appreciation to my thesis director, Dr. Jean Rush, for her support and assistance during the preparation of this thesis. I also thank the members of my committee, Dr. Robert Cardinale and Professor Carl Heldt, for their support and interest, and Dr. Dale Fitzner for his research direction.

I also want to express my gratitude to my husband, Dave, and my children, Jeff, Danielle, and Gabi, for their encouragement and self-sufficiency, which made writing this thesis possible.

Acknowledgement is also given to present and future educators and their interests in furthering knowledge. For expanding my own humanist concerns, I am indebted to the extensive research contributions of others. I also acknowledge that I am a human being.
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ABSTRACT

This thesis discusses current neurological, psychological, and educational research into hemispheric specialization of the human brain. Split-brain theory assigns separate thought processes to the two hemispheres of the brain and implies that traditional education teaches the left hemisphere and ignores the right. Certain educators, recognizing the importance of developing creative thinkers, have applied this theory to their teaching methods that incorporate the visual arts.

More scientific research is needed to verify the educational implications of split-brain theory; however, researchers believe that enough is known to motivate educators to develop policies in an effort to provide full intellectual potential. Arguments for and against split-brain theory are presented as well as a review of literature for further investigation.
CHAPTER 1
INTRODUCTION

During the past 20 years, research relating the functions of the brain's two hemispheres has uncovered facts about the human brain that are considered relevant to pedagogical practice (Cohen, Noblin, Silverman, & Penick, 1968; Galin & Ornstein, 1972; Gazzaniga, 1967, 1975; Gazzaniga, Bogen, & Sperry, 1965; Geschwind, 1979; Levy, Trevarthen, & Sperry, 1972; Sperry, 1964). Knowledge of independent learning and memory functions of the separate hemispheres of the human brain was uncovered by neurosurgeon Roger Sperry and his associates at the California Institute of Technology in 1961. Their findings emerged from efforts to control the transfer of epileptic seizures in patients by surgically severing the corpus callosums, thus called split brains. Sperry (1975) and others (Bogen, 1975; Nebes, 1975; Rennels, 1976; Sage, 1976) call our attention to the main theme arising from this research, that there appears to be two modes of thinking and that modern society and traditional education discriminate against the right hemisphere.

Hemispheric specialization was first discovered in the brain of a cat in the early 1950s. Further research with monkeys and chimpanzees, and then later in the
surgically disconnected hemispheres of epileptic humans and in brain-damaged humans, confirmed original findings. Psychologist Robert Ornstein and his associate, David Galin, were intrigued and attempted to determine if the same bilateral functions could be established for normal people doing ordinary things. They placed electrodes over areas of the brain that were shown the most functionally asymmetrical through brain damage and the electroencephalographic (EEG) recordings were consistent with Sperry's hemispheric functions (Kiester & Cudhea, 1976).

These experiments caused a sensation in scientific fields. Probably their first exposure to the general public was through an article titled The Two Brains in Newsweek, August 1973. Shortly after The Brain Changers: Scientists and the New Mind Control was published, and We Are Left-Brained or Right-Brained appeared in the New York Times Magazine (Pines, 1973a, 1973b). From this point, the specializations attributed to the right hemisphere intrigued art educators.

These right hemisphere specializations also emerged as being responsible for dreaming (Bakan, 1976; Gazzaniga, 1975); the reason why creative people are different (Martindale, 1975); as new intellectual insights for artists (Virsup, 1976); the reason why children are not learning (Williams, 1977); the new way to teach reading comprehension (Rico, 1978); a necessity for information
processing (Haber, 1970); a new way to teach languages (Miele, 1978); a requirement for problem solving (Brandwein & Ornstein, 1977); and as being responsible for perceptual processes that produce executive abilities (Glassman, 1977).

Numerous experiments have been conducted in an attempt to support split-brain theory and have shown results of various degrees of reliability, but many have been interpreted as being consistent with the original split-brain experiments. Several educators have proceeded with available evidence and are experiencing success with their teaching methods (Adams, 1976; Edwards, 1979; McKim, 1972; Miele, 1978; Rico, 1978; Samples, 1975; Weiss, 1977).

Those opposed to split-brain theory have called it a bandwagon (Gainer & Gainer, 1977; Gardner, 1978), a fad (Goleman, 1977), and have accused art educators of blatant overgeneralization (Youngblood, 1980). Most of the opposition agree that there is not enough pure scientific evidence discriminating the functions of the two hemispheres to proceed with putting the theory into educational practice, although they accept the premise that there are two modes of thought (Teuber, 1974).

In light of conflicting points of view, to-take-the-ball-and-run or to-sit-and-wait, educators must consider what has been agreed upon—two modes of thought. In his interpretive essays, Jerome Bruner (1979, p. 5), professor
of psychology at Oxford University, supported humanist efforts: "It is economical to report the products of research and not the endless processes that constitutes the research itself... we may be concealing some of the most fruitful sources of our ideas from one another." Bruner approved of and encouraged intuition to further the cause of knowledge. He theorized that we can only discover mathematical properties because we know so little and stated, "one proceeds by intuition and metaphor hoping to be led beyond to a new rigor... the economical combinings of the scientist and the artist share far more than we are often prepared to admit" (p. 66). Bruner was concerned with how we impart knowledge and how we learn. He cautioned imposing a fetish of objectivity and was convinced that the human mind must engage in inquiry and conduct internal dialogue as the basis of thought to construct reality.

Albert Einstein, who possessed one of the most creative minds in modern times, provided insight into his thought processes,

The words or the language, as they are written or spoken, do not seem to play any role in my mechanism of thought. The physical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be voluntarily reproduced and combined. The above mentioned elements are, in my case, of visual and some of muscular type. Conventional words or other signs have to be sought for laboriously only in a secondary stage, when the mentioned associative play is sufficiently established and can be reproduced at will. (cited by Adams, 1976, p. 28)
Biologist Thomas Huxley (1971, p. 38) stated that "The method of scientific investigation is nothing but the expression of the necessary mode of working of the human mind." He pointed out that phenomena can be explained by hypothesis, which we should not consider untrustworthy simply because it is an hypothesis. Mathematician Jacob Bronowski (1971) admonished that there is no comfort or progress in bickering. Bronowski disparaged turning things into a game by taking sides and instead encouraged providing links that give society life.

When men misunderstand their own work, they cannot understand the work of others; so that it is natural that these scientists have been indifferent to the arts. . . . There are of course people who like to draw a line between pure and applied science; and oddly, they are often the same people who find art unreal. . . . I challenge all these judgments. (p. 47)

Regarding pure scientific research and the split brain, neuroscientist Francis Schmitt (1978, p. 1) revealed that

Until now no detailed, self-consistent theory has been proposed that specifies and functionally characterizes the operational repertories at the level of molecules, individual neurons, or groups (circuits) of neurons and that explicitly defines the postulated information-processing mechanism.

Neuroscientist David Hubel (1979) inferred that perhaps difficulty with brain research is semantic. He said that those who discuss the physiology of the mind are interested, but he can't see how they could ever know
because the definition of the word mind, as it refers to the brain, is elusive. Brain research is an old field of investigation and yet we are only at the beginning. Even with advances in techniques, there is no known way of studying the signals of a single cell in a normal, live human brain without opening the skull, which is highly unethical. New methods are needed to study the functions of the brain from outside the skull.

This thesis presents facts about the split brain and their proposed implications for education and the visual arts in a descriptive way and does not too closely associate them to any one theory. Educators must decide which interpretation of the given information provides the most promise for further investigation and possible educational practice. This treatment of the subject is necessary because the literature contains little scientific research, much speculation, and is extensive. The discussion presents the most basic and relevant aspects of the subject and at the same time provides a list of references for further study.
CHAPTER 2

SPLIT-BRAIN THEORY AND CREATIVITY

The hemispheres of the human brain have been found to process certain kinds of information separately and more recently have been found to complement each other's functions (Gazzaniga, 1976; Geshwind, 1979). Research has established that functions apparently controlled by the left hemisphere are linear and can be described as verbal, analytic, rational, digital, and logical. The right hemisphere is thought to control lateral thought-processing skills that have been described as synthetic, analogic, spatial, intuitive, pictorial, holistic, and emotional. Educators have inferred from split-brain theory that their teaching methods and content are more compatible with left-brain than right-brain information processing and that failure to educate both halves of the brain may have been the result (Brandwein & Ornstein, 1977; Hunter, 1976; Weiss, 1977). Thinking processes associated with right-brain functions are those often cited as creative behavior, which is sought in education as well as industry (Howard, 1980).

Before split-brain research emerged, the dichotomy of the mind was discussed in terms of creativity. Alfred North Whitehead's speculative theory of creativity was
based on generalizations drawn from his own experience. His principles did not lie in crucial laboratory experiments but in their success in the conduct of life. He appealed to the intuition of experience. Whitehead described creativity as a complete achievement of varied mental activity involving an artistic sense. He was adamant that "knowledge is important only insofar as it can effectively lead to the release of creativity—if it cannot be used for this purpose it is inert, dead" (Burnett, 1957, p. 227).

From his experience as a physics teacher, G. W. Steward (1950) described productive thinking as a mental activity that produces a new result from what is already known. Steward believed in the transfer of one mental function to another, since progress in thinking depends upon change in thought focus, and stated that productive thinking can be taught.

Drawing on the theories of Freud, Jung, and Gestalt psychology, advertising man Alex Osborn, author of Applied Imagination (1957), offered advice on how to achieve creative thinking in the 1930s. Osborn said that the thinking mind was twofold: a judicial mind to analyze and compare and a creative mind to visualize and generate ideas. Osborn said that the judicial effort and the creative effort are alike except that the creative mind produced an idea instead of a verdict, that both imagination and judgment are needed
for creativity, and that "painting and drawing can't fail to put imagination through its paces" (p. 41). To free the flow of ideas, Osborn developed the popular brainstorming theory used extensively in industry to remove premature closure, which he assumed was the barrier to creativity. University of Buffalo students taught according to the concepts in Osborn's book showed superior creative ability and an improvement in creative productivity over those who did not take the course (Parnes, 1975).

Niles Howard (1980) revealed that scores in creativity tests drop about 90% between ages 5 and 7, and that by age 40 an individual is only 2% as creative as he was at age 5, which "suggests to psychologists that the almost total emphasis on logical thought in education may effectively suppress creativity. The hope of creativity research is that what is trained out can be trained back in" (p. 38).

Educator Syndell Weiss (1977) observed the need for procedures to capitalize on different kinds of learning in the affective and cognitive domains, which function interdependently. Weiss stated that each brain hemisphere adds relevance to all learning and that this interhemispheric activity expands cognitive learning so that it is better remembered. Weiss said that the identification of creativity as a necessary component in developing cognitive learning might encourage teachers to change curriculums in order
to develop skilled learners who think while they learn. Weiss assumed that anyone with sufficient mentality (regardless of how it is measured) could be trained to use the processes of creativity.

Creativity has been described as "both the art and science of thinking and behaving with both subjectivity and objectivity" (Koberg & Bagnell, 1976, p. 8). E. P. Torrance approved of individuals being educated to develop their talents fully and rejected pressures to develop the intellect only through the three Rs. Torrance (1975) and others (Guilford, 1967; Koestler, 1967) believed that an individual's mental functioning was restricted if creative thinking remained undeveloped, because there is a cross-fertilization between two cognitive acts in a single brain. Regarding the difficulties of scientific research on the brain's hemispheric specialization and interhemispheric cooperation during thought processing, Koestler (1967, p. 341) said, "We are trying to understand a system that operates at millisecond speeds; we are not likely to find out much by taking one reading every five minutes, or even five seconds." He indicated that it would not be easy for the brain to develop techniques to understand itself.

John Eccles (1958), a professor of physiology and biophysics, described the activity of the brain as connections between neurons, known as synapses, which secrete specific chemical substances at high speed and allow neurons
to transmit impulses to one another. Eccles (1973) postulated that the brain is not a fixed structure and that synapses are in various stages of activity, which leads to their growth. The better the learning the better the growth, and the better the growth the better the thinking. Hubel (1979) stated that knowledge of synaptic activity is far from understanding how the brain works, but it provides a foundation. Because the brain contains an estimated $10^{14}$ synapses, therefore, brain research has a long way to go.

EEG experiments have attempted to support hemispheric specialization. Colin Martindale (1975) associated the right hemisphere with primary process or creative thought and the left hemisphere with secondary process or intellectual thought. Martindale observed alpha waves and found that alpha patterns varied among subjects during creative and intellectual tasks. From these experiments Martindale assumed that creativity and intellectual ability required two different thought processes and that highly creative people process information differently than the less creative.

Other EEG experiments (Galin & Ornstein, 1972) attempted to evaluate the interaction of hemispheric activity in normal subjects during verbal and spatial tasks to distinguish between cognitive modes. Their findings of distributed electrical activity in the normal human brain
apparently supported functional asymmetry and interhemispheric relationships comparable to those found by split-brain experiments with cats, chimpanzees, monkeys, and brain-damaged or severed human brains (Gazzaniga, 1967; Gazzaniga, Bogen & Sperry, 1965; Sperry, 1964). These researchers concluded that the corpus callosum serves the important function of allowing the two hemispheres to share learning and memory and does not just hold the two hemispheres together as it was once thought (Bogen, 1974; Kinsbourne, 1974). Gordon (1974) explained that the corpus callosum is not only the largest of the cerebral fiber systems, but one of the few brain structures that has not been divided into right and left symmetrical parts.

Colin Blakemore (1977) summarized several split-brain experiments on human subjects with severed hemispheres wherein emotional reactions were given by one hemisphere to the incorrect answer or performance of the other. Blakemore stated that "if the cerebral hemispheres are capable of this kind of collaboration with no overt connections at all between them, how much more certain should they be to share their skills when they have millions of fibers in the corpus callosum to bind them together" (p. 165). He went on to say that we should not pamper one hemisphere and neglect the other but strive for harmony of the two.
Split-brain theory is not new. In 1860, Paul Broca, a French investigator, discovered that when a particular area of the left brain was damaged a speech disorder occurred, but when the same area on the right brain was damaged speech remained intact (Gardner, 1975). Sigmund Freud discussed cerebral disconnection in his neurologic essay on aphasia. A model for thinking that parallels later discoveries could even be traced to Thomas Aquinas who wrote that the mind cannot understand thoughts without images, or even further back to Aristotle who stated that it was impossible to think without a mental picture. Michael Gazzaniga (1975, p. 12) stated that research on split brains "encourages us to think in modes of consciousness. We must assume that what writers, poets, and scientists have been telling us for centuries is true" when an attempt is made to determine how neurological systems encode psychological information.

Functional asymmetries matched with anatomical asymmetries may be related to the functional specializations of the two hemispheres particularly with respect to the verbal dominance of the left hemisphere. A striking asymmetry is seen when the sylvian fissure is cut open revealing a larger region of Wernicke's area on the left side of the human brain. Wernicke's area is the part of the brain discovered to be responsible for speaking and also the comprehension of the spoken, read, and written word.
The distribution of asymmetries in the human brain can vary with handedness. Most of the human population (91%) favors the right hand, which is controlled by the left side of the brain. Speech centers are located in the right hemisphere in only 2%, however; most left-handed people have speech centers in their left hemisphere (Eccles, 1973). The hemispheres of the human brain have been shown to be bimodal through research on brain-damaged, split-brain, and normal subjects. Even though the left hemisphere is said to be dominant for language, it was discovered that the right hemisphere also has a verbal capacity (Geshwind, 1979). Therefore, both hemispheres must interact to ensure full intellectual capacity. Hubel (1979) stated that since physiology is impossible without anatomy, the discovery of anatomical asymmetries will undoubtedly lead further into unraveling the mystery of the mind.

The creative thinker is deemed most necessary by education and industry. Prior investigation into the speculative modes of creativity are supported by findings on hemispheric specializations of the human brain. If research on split brains is valid, the necessity of developing creative thinkers will surely provoke curriculum revisions. Educators will include teaching methods that will develop right hemisphere information processing to complement the left in an attempt to develop an individual's full intellectual potential.
CHAPTER 3

IMPLICATIONS OF SPLIT-BRAIN THEORY FOR EDUCATION

The right hemisphere apparently relies on imagery rather than on language, and this kind of thinking is considered a cognitive system in its own right, capable of problem solving. The right hemisphere has been labeled visual or lateral, which is said to increase cognitive options, enhance conceptual flexibility, and lead to creative thinking. Lateral thinking has been defined as sideways thinking, which utilizes different viewpoints and different approaches to develop new ideas and fresh approaches. Linear thinking, which is associated with the left hemisphere, is defined as careful, logical analysis that concentrates on reaching an answer from the given data (de Bono, 1973). Many educators recognize lateral thinking as being necessary to realize the full potential of the brain's capacity.

Neuroscientists and psychologists responsible for the split-brain theory believe that the results of their research should be of interest to educators. Neurosurgeon Joseph Bogen (1975) discussed implications for improving education extending from what is known about hemispheric processes of the human brain. Hemispheric specialization,
he said, is not so much in the material but in the way in which the material is processed. Bogen suggested that since we are now aware of hemispheric specialization, education should be designed to stimulate the brain processes that have been ignored in favor of verbal and analytical ones. Bogen (1975) and Galin (1976) admitted uncertainties in the split-brain theory but strongly believed that enough is known to motivate educational policies and practices.

"Since education is effective only insofar as it affects the working of the brain . . . a program restricted to reading, writing, and arithmetic will educate mainly one hemisphere, leaving half of the individual's high-level potential unschooled" (Bogen, 1975, p. 27). Sperry (1975) stated that traditional education discriminates against the specialized functions associated with the right hemisphere. A challenge is presented to professional educators by their suggesting equal time to each hemisphere as a possibility to save the student from neglect.

Psychologist Robert Ornstein, who popularized the split-brain theory, discussed cognitive behavior from a split-brain viewpoint and presented arguments for integrating both left- and right-brain kinds of knowledge. "We have all been educated to tune out subtle internal stimuli and direct attention outward, toward the external world, in order to survive" (Ornstein, 1972, p. 188). Ornstein
emphasized that we must educate the intuitive mode of the right hemisphere to extend intellectual knowledge. Arthur Deikman (1971) agreed and stressed the importance of recognizing the different modes of consciousness necessary for intellectual growth.

Neurologist Richard Restak (1979) concluded that with the collapse of philosophy and theology as major influences on our lives the ultimate intellectual challenge is in brain research. Restak linked language and motor behavior studies to left-hemispheric dependency because about 98% of right-handed children and adults respond to questions requiring verbal thought by eye movements to the right, actions which he believed identify a person's cognitive style. Restak also concluded that boys think differently than girls on the basis of recent EEG brain research (Buck, 1976; Kimura, 1973; Krashen, 1975; Witelson, 1976). He noted that when boys are involved in tasks employing spatial concepts the right hemisphere is activated consistently, while girls are more likely to activate both hemispheres, indicating spatial ability is more widely dispersed in the female brain. Restak indicated that the male brain learns by manipulating its environment and is primarily visual, and thinks differently than the female brain because the male brain is organized differently. Kimura (1973) developed a technique called dichotic
listening, which provided additional support about hemisphere specialization in the normal human brain. This has been of interest to music educators because it has been discovered that one of the functions of the right hemisphere is the perception of melody.

Merl Wittrock, a professor of educational psychology at UCLA, discussed results of extensive studies on human learning under his direction (Wittrock & Goldenberg, 1975). Wittrock identified the generative process of learning, which he associated with later research on hemispheric specialization. Wittrock reviewed educational methods from ancient Greece and Rome to the Renaissance and found that imagination was the essence of facilitating learning. Verbal and spatial methods declined in their use of imagery, he added, with the emergence of the printed word. Wittrock believes that contemporary education results from behavioristic theory and that students act to obtain reinforcement or reward.

Commenting on one of his many experimental learning studies, Wittrock (1977) concluded that imagery is the single most important variable in determining free recall in learners. He reported that one year later children trained to use imagery could recall certain concepts that were previously thought to be too complicated, based on Piaget's levels of intellectual development for children.
Wittrock also determined that when students generated and produced their own images through drawing they had better recall of verbal material. He explained that this elaborating of verbal material imaginally enhances recall because the information is processed in two different ways. Wittrock's work indicated that teaching is more than the reinforcement of correct responses and that students learn by actively constructing meanings. He urged educators to devise sophisticated ways to facilitate the multiple processing systems of the brain.

The suggestion that schools have handicapped learners by limiting instruction to left-brain inputs of reading and listening and left-brain outputs of talking and writing is widely believed (Fransecky & Ferguson, 1973; Galin, 1976; Grady, 1976; Hunter, 1976; Ogletree, 1974; Randhawa, 1971; Sagan, 1977). Max Rennels (1976) stated that children can develop mentally only when the balance of the functions of hemispheres becomes of concern to educators. Ralph Haber (1970) concluded from his perception experiments that when pictorial memory processes are compared with verbal and mathematical memory processes, it is clear that the two systems are different.

Short-term memory has been associated with the left hemisphere and long-term memory with the right hemisphere (Buck, 1976; Haber, 1970). Buck reported that when this
twofold nature of mentality was applied to absolute judgment experiments, it was found that seven items of information marked the point at which brain processing switched from left- to right-hemisphere dominance. Apparently short-term memory can recall only six unrelated items without loss. Recall of seven or more items indicated that recognition of large numbers of items depends on another type of representation in memory without labels, suggesting imagery.

Educator Leslie Hart (1975) explained that current educational practices ignore the human potential for growth. "The main issue is motivation in education—it's not applied to learning as a continuing process of life, but to do what the teacher directs, when and as directed, and stopping when told to do so. If I instruct my tulips to bloom on a certain Sunday because company is coming, I could expect results about as reliable" (p. 34). Hart said that the right brain in children has been atrophied by left-brain education. "We do not need to urge children to use their brains. Our big task is to get out of their way" (p. 39). Jerre Levy (1974) showed us a simple but most accurate expression of the functions of the brain's two hemispheres through the drawing of a young split-brain patient. His drawing of a man showed the man's right side visualizing a girl and his left side conceptualizing her meaning with the letters LUV.
Concerned educators, realizing the importance of developing both the creative and the logical thought processes, have accepted the split-brain challenge for education. They have elevated the creativity to a status of importance and have developed teaching methods to produce creative thinking that they felt are successful, many of which incorporate the visual arts.

Tony Buzan (1976), an expert in reading techniques and memory systems, wrote *Use Both Sides of Your Brain*. This is a step-by-step book for students and contains exercises to discover the functions of the right side of the brain while simultaneously using the left side more effectively. Buzan stated "The mind is perfectly capable of taking in information which is non-linear . . . photography, illustrations, diagrams, etc. It is only our society's enormous reliance on linear information which has obscured the issue" (p. 87). Non-linear note taking and study methods are emphasized to ensure what Buzan considered to be interactive, stimulating experiences rather than impersonal and tiresome tasks.

Robert Samples (1975) advocated educating the metaphoric and intuitive hemisphere of the human brain as well as the rational-linear one. Samples's experiments with the intuitive mode suggested that learning situations structured "along strictly rational lines resulted in low
interest, superficial involvement, and singularly low impressions on the students. The activities that had a high metaphoric-intuitive component generated more excitement, involvement and transferability" (p. 25). Samples perceived that teachers could encourage creativity and invention and extend rationality and logic at the same time. He further stated that when they do, they will create student's minds that will be greater than the sum of their parts.

A new technique called suggestopedia (Miele, 1978) was developed by psychotherapist Georgie Lozanov to teach languages. Lozanov's system attempts to engage both hemispheres of the brain. Music is played in the background so that the right hemisphere will absorb signals that have nothing to do with the learning task but will remain open to the experience. The logical, critical left hemisphere will be passive, allowing the language teaching to piggy-back in. Language teaching using this technique can be accomplished in one-fifth of the time required by traditional methods.

Gabriele Rico (1978) is a consultant on the implications of hemispheric specialization for education. Rico has developed methods for teaching reading that attempt to utilize the different information-processing capabilities of the two hemispheres. Drawing from brain research, she
stressed reading for nonliteral meaning to form a Gestalt in the mind, instead of beginning and ending with detail that leads to premature closure. The bilateral process of reading for the nonliteral, Rico claimed, provides options for exploration and the conception of ideas. Rico pointed out that art can contribute in a fundamental way to reading ability because reading is a visual skill related to perception and information processing.
CHAPTER 4
IMPLICATIONS FOR VISUAL ARTS EDUCATION

Most art educators have adopted the right hemisphere with its attributed functions as their side of the brain. Some have supported these functions of the human brain before the research became widely known. In 1969 Rudolph Arnheim argued the importance of teaching visual thinking as a powerful and basic means of knowing and reasoning to develop integrated thinking processes in students.

Elliot Eisner (1978, p. 615), professor of education and art at Stanford, supported Arnheim's theory by stating, "The current emphasis on the production of measurable completeness in the three Rs is creating an unbalanced curriculum that will, in the long run, weaken rather than strengthen the quality of children's education." Eisner said that the mind depends on various forms of knowing to develop ideas and that students will be deprived if the ability to use any particular symbol system for conceptualizing is denied. The arts, the sciences, and the humanities are all cognitive; education must include artistic as well as scientific modes of inquiry to do justice to the potential of the mind.

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Many educators have advocated making visual art an integral part of the standard curriculum, implying that art is unique among other popular educational methods in developing the attributed right-hemisphere thought processes. Massive visual atrophy is likely to occur because of a mental ability that is not exercised, and imagery is basic to solving many problems (Vannatta, 1979). The significant responsibility of education is to develop critical consciousness, and art education can support this development (Lanier, 1975). Arts are basic to the context-building function and contribute to the learning of the three Rs, and imagination is important for every form of cognition (Broudy, 1978). Educators may be damaging the brain if they don't cultivate the creative as well as the analytic side since a person needs to think in images as well as words to evoke a mind-body system (Williams, 1977). Neurological symmetry has long been a concern of art educators (Rennels, 1976).

Several educators have expanded their split-brain beliefs to actual classroom practice and have reported the results. Roger Williams (1977) claimed that art-centered schools aid cognitive development. He stated that arts are not only beneficial in themselves but their introduction into curriculums also resulted in improvement in mathematics, reading, and science. He cited the successes of art programs nationwide and noted that an added benefit is the
display of enthusiasm that students show toward all of education. Williams emphasized that in visual art, the students use their minds along with their hands and eyes and that no other subject offers this interaction. He admitted that the answer is not clear on how the arts help children learn but he believed that hemisphere specialization plays a role.

Robert McKim's (1972) *Experiences in Visual Thinking* is used as a text for a popular undergraduate course in mechanical engineering at Stanford. McKim discussed conceptualization, drawing, and problem solving. He explained imagery in an effective and experiential way, and argued for the importance of visual thinking. McKim stated that truly creative people are capable of receiving information with the left hand (right brain) and of transferring and expressing with the right hand (left brain) and that therefore "visual and language functions are complementary" (p. 21). To McKim, reliance on language alone stands between the thinker and reality. He concluded that the creative thinker is ambidextrous or, in other words, uses both sides of the brain.

Educator Edward de Bono (1969, 1973) espoused the virtues of right-brain thinking. De Bono (1973, p. 108) emphasized that the two thinking processes are complementary and warned that "education is soundly based on the need to
be right all the time . . . the danger lies in the arrogance of the attitude that assumes that vertical thinking is sufficient. It is not. Exclusive emphasis on the need to be right all the time completely shuts out creativity and progress." De Bono subscribed to the idea of using visual art to teach lateral thinking and the ability to generate students' alternate ways of looking at things. He believed creativity could be developed and improved through his techniques and offered his ideas to other teachers for increasing creative thinking in students.

James Adams, professor at Stanford's School of Engineering, considered himself a successful teacher of the methods he discussed in his book *Conceptual Blockbusting* (1976). Adams maintained that students interested in grades are not as creative as they could be. This is consistent with Wittrock's criticisms of the behaviorist theory of education. Adams described students as being highly verbal, less competent visually, and therefore possessing conceptual blocks to problem solving. He believed that his intuition as a teacher guided his direction in an effort to produce creative thinkers. To aid students to develop visual imagery as a thinking mode, Adams encouraged drawing, not only crude informative drawing but also skillful drawing, as a powerful conceptual aid. He believed that drawing is a thinking technique as well as a communication device and that it is invaluable in problem solving.
The most recently publicized visual art education research and practice evolving from split-brain research comes from the classrooms of Betty Edwards, art professor at California State at Long Beach. In preparation for her doctorate, Edwards randomly selected 84 untrained students and attempted to support her theory of teaching drawing skills through right hemisphere training. Edwards compared two instructional techniques with the students, a traditional one that presumably activated the left hemisphere and her own method that was designed to activate the right hemisphere. Students instructed according to Edwards's right hemisphere techniques scored significantly higher than students who received traditional drawing instruction (Simross, 1977). Edwards concluded that the difference in performance between the two groups supported her hypothesis that right-hemisphere training produces greater accuracy in drawing.

Edwards combined art education theory with recent discoveries in split-brain research and developed methods of teaching drawing by exploiting the special functions of the right hemisphere. Her teaching methods were developed over a 10-year period. Edwards described her method as a cognitive-shift model of learning, which she believes has been successful with students of all ages. Neurosurgeon Sperry endorsed Edwards's application of brain research as
conforming to available evidence and said that Edwards reinforced and enhanced the right hemisphere functions (Edwards, 1979).

Edwards emphasized that her research was fundamental and more important than the fact that her technique can teach students to draw. She said her method can gain access to the right hemisphere and can be used for all education to activate both right- and left-hemisphere functions. Edwards hypothesized that if functions of the right hemisphere such as intuition, imagination, and creativity are never trained, they may be as atrophied as the ability to draw. Her students have commented that when learning in the right hemisphere mode they could concentrate more intensely and were more interested (Chase-Marshall, 1978).

Although Edwards developed her teaching method to solve an instructional problem, she contributed to split-brain theory by showing that art is a vehicle for reaching and activating the attributed functions of the right hemisphere. Along with neuroscientists, brain surgeons, and psychiatrists, Betty Edwards represented the visual arts during the February 1980 report on recent developments on the human brain on NBC's Today Show by discussing her teaching methods.
Art educators have commented on art's low position in the school curriculum as the result of our left-brain-oriented society with its negative attitude toward the creative arts (Vannatta, 1979). Kenneth Marantz (1977, p. 10), Chairman of the Art Education Department at Ohio State, faults art educators. "Defining art has been a philosophical plaything for at least a couple of thousand years and it remains so today . . . art has lost all meaning because it can mean almost anything anybody wants it to mean . . . the modern art teacher has chosen the easiest and most culturally acceptable piece of the business."

Marantz further commented that most elementary and secondary art courses consist of manipulating art materials to make an art object and is mere baby sitting. He strongly believed that visual art is a necessary learning experience that can sharpen aesthetic response but that art cannot perform its function as long as it is relegated to a subservient and isolated place in curriculum. Art professor Vincent Lanier (1975) agreed with Marantz that if art remains totally a studio learning experience it cannot attain the stature of its potential. Marantz considered art education a sleeping giant and urged art educators to respond and improve the poor status of art education in the schools.
In light of budget cutbacks Williams (1977) cautioned art educators not to be content with art for its own sake but to become involved with the entire mind-body system important in education. He reminded us that, unlike athletics (another favorite target in budget cuts), the art teacher can never possess the advocacy base that athletics has in public goodwill. The coach knows how to hustle and survive.

Harry Broudy (1978), a professor of educational philosophy, discussed the arts as basic education because they contribute to the learning of the three Rs in a context-building sense. He admonished that as long as arts education is restricted to the skills of expression, arts will remain frills in education. Instead, the arts should prove themselves the fourth R. Broudy (1978) and Lanier (1975) agreed that the skills of aesthetic perception qualify as instrumental skills for associating and interpreting knowledge.

Most art educators have adopted the right hemisphere as their side of the brain. Some disagreement with split-brain theory and its implications for education has emerged, however (Gainer & Gainer, 1977; Gardner, 1978; Goleman, 1977; Youngblood, 1980). Howard Gardner, psychologist, art researcher, and co-founder of Harvard's Project Zero, attempted to bring split-brain theory into scientific
perspective. He cautioned that the existence of two hemispheres became too alluring and that these discoveries swayed educators to jump on a bandwagon without the benefit of pure scientific research. Gardner (1978) admitted that investigations into split brains have interesting implications but stated that all theories regarding education and the split brain are nothing but speculation because findings are incomplete and scientifically inconclusive. Scientific evidence is needed, he stated, even to define what is meant by intuition and consciousness. "Scientific enterprise is too precious to be sacrificed to any cause, however worthy it may appear" (p. 119). Gardner placed pure scientific evidence well in advance of theories but does encourage further research on split-brain theory.

Ruth Gainer and Harold Gainer (1977) sensed that art educators were panicking, attempting to justify their school programs, and conveniently adopted the right hemisphere as a rationale. Gainer and Gainer admitted that they believed in the existence of different learning styles, even though there is little scientific information, but they pointed out that there has been gross oversimplification of activity associated with each hemisphere, such as painting for the right and writing for the left. They explained that art can contribute to learning but that educators must take time for critical evaluation of the
topic. Art as a contributor to learning was the theme of a book co-authored by Elaine P. Cohen and Ruth S. Gainer (1976) titled *Art: Another Language for Learning*. The book considered art an integral part of the school experience and suggested integrating visual art with other subjects. Cohen and Gainer emphasized inductive learning, or the discovery approach, to show the value of art in the school curriculum.

Michael Youngblood (1980), a professor of art at the University of Southern Illinois, criticized all art educators who have adopted hemispheric specialization as making "blatant overgeneralizations and speculations of fact" (p. 44). Youngblood considered Edwards's methods as pushing overgeneralizations even further, however, and contends that she failed to provide evidence to support her claims. He stated that it is absurd to suggest that art learning is a function of the right hemisphere. Youngblood believed that scientists have come up with nothing conclusive regarding hemispheric specialization in their research and that these assumptions on hemisphere functions are physiologically incorrect. He reminded us that hemispherality research is very tentative and that research must be final before hemispherality can be considered worthy in education. Youngblood argued that schooling now encompasses opportunities for teaching all right-hemisphere functions.
Daniel Goleman (1977), associate editor of Psychology Today, considered split-brain psychology as just another fad. He assumed that the appealing simplicity of the split brain had been seized upon to explain everything. Goleman said that the core of every fad that is more or less truthful contains wishful and woolly speculation, which is based on misinterpretations of the facts that attract attention. He speculated that when research on this hemisphere vogue is conclusive, we will be shown that the right brain is no more or less important than any other part. Goleman indicated that the availability of grant money was responsible for the continuing split-brain fad, and he predicted that the hemisphere specialization excitement would soon peak.
CHAPTER 5

CONCLUSION

Art educators disagree on the place of art in the schools. Should it remain a separate discipline or should it be integrated with other disciplines? In 1871, the visual arts were a part of formal education for vocational reasons. By 1940 the development of creativity had become a reason for art education, and later visual literacy, in the sense of perceptual proficiency, became an object of art programs. Aesthetic education attempted to integrate all the arts with other disciplines, while at the same time the National Endowment for the Arts and Humanities promoted professionalism in the Artists-in-Schools program. Art education often has been considered a frill, and it also has had an artsy-craftsy or busy-work connotation. Now art educators are focusing on art as cognitive learning. Many teachers see split-brain theory as preventing the demise of visual arts in schools beleaguered by inflation and budget cuts. Art educators, hoping to demonstrate to a visually naive public that art is vitally important to the educational process, argue that art education can develop the potential of the ignored right hemisphere.

The need for a broader curriculum in art was identified through the 1964 Seminar on Elementary and Secondary
School Education in Visual Arts held at New York University and the Seminar on Art Education for Research and Curriculum Development held in 1965 at Pennsylvania State University. These and other U.S. Office of Education-funded (USOE) conferences were organized to stimulate research and curriculum development. They established the importance of visual art as a discipline in itself by focusing on the status of art education, summarizing viewpoints for inroads to problems, and determining inconsistencies and the need for definition of concepts in the stated goals of art education (Mattil, 1966). They failed to generate much research, however, primarily due to cutbacks in government research funding in the arts (Hoffa, 1970). The New York University conference led to the Artists-in-Schools (AIS) program, artists teaching art to school children in order to enhance their perception and their ability to express creatively. The validity and justification of the AIS program has been questioned because uncertified artists were replacing certified art teachers in a school program without a stated educational policy (Smith, 1977).

The Central Midwestern Research in Education Laboratory (CEMREL) developed an aesthetic education curriculum to remove the arts from a total studio existence. The concept incorporated experience and cognitive learning that focused on the individual rather than on the discipline
and stressed visual literacy for its capacity to place meaning and value in images. Aesthetic education linked the arts to other subjects to provide a comprehensive general aesthetic education for all students. CEMREL's curriculum was concerned with the introduction of aesthetic values into instruction, both to display integrity in the arts themselves and to integrate arts into the school curriculums as carriers of aesthetic content, to develop aesthetic ways of perceiving and knowing (Madeja, 1976). CEMREL developed instructional resources and materials for grades K-6. The program has been funded by the National Institute of Education. Eisner (1978) agreed that the arts are cognitive and that the development of the whole human being is the most necessary responsibility of education, which can only be accomplished through the inclusion of art into the school curriculum, but he insisted that visual art must stand as much on its own as any other subject of importance.

The Arts, Education and Americans Panel (1977), chaired by David Rockefeller, Jr., published *Coming to Our Senses*. The panel considers arts as a necessary human experience and therefore a necessary part of the school curriculum. It questioned the integrity of a curriculum that denies the arts. Unlike CEMREL, the panel adopted the view of learning through the arts. Also, it involved
the community in educational policy and it endorsed the Artists-in-Schools program. The report proposed that arts are cognitive but treated them as affective and recommended that artists, exempt from certification, teach classes. This is contrary to the report's proposed cognitive application of the arts. The report was designed as an instrument for publicly describing the importance of art in the schools, and as a vehicle for securing federal funds, but falls short of proving the true educational benefits of the arts (Efland, 1978; Smith, 1978). The panel offered 96 recommendations which were presented in Congressional hearings and are under study.

Split-brain research has not provided answers for keeping arts programs in the schools, but it has posed questions that may give direction in an area in which there is little information regarding education. Only through more research will educators be able to understand the brain's functions and use this information to teach students how to use their intellectual capacities. Research on the split brain does challenge the linear approach dominant in education and emphasizes that both lateral and linear thought processes must be activated in optimal education. If research about the split brain is correct, current educational practices are denying students the full use of their thinking potential.
Neurosurgeons, psychologists, and educators have correlated visual art with the functions of the brain's right hemisphere. The implications for art education are recognized. Awareness of the role of lateral asymmetry in the human brain has created an educational environment that may encourage educators to integrate art into conventional curriculums, not as a pure studio expression but as a cognitive learning discipline. This suggests that art educators should devise experiments to determine which method of teaching produces maximum learning. On the basis of their findings they could develop art programs that are appropriate to the goals of art education. What is learned and how learning takes place must be realized in order to determine whether art is a mode of knowing and whether art has a place in the classroom. When the Arts and Humanities Program of the USOE disbanded in 1970, funding for arts research projects was cut off and the significant progress made over a 5-year period was at a standstill (Murphy & Jones, 1976). Art education must begin again with sustained inquiry.

New learning theories have evolved from extensive research on the split brain, and teaching methods have been generated in an effort to develop right hemisphere thinking processes to complement the functions of the left hemisphere. Perhaps the most comprehensive aspect of these
philosophies is the desire to develop the total human being through full intellectual potential. The integration of visual art is seen as an effort to teach the whole person, with an emphasis on creative output by the learner. Several educators (Adams, 1976; McKim, 1972; Samples, 1975) have developed teaching methods toward this end. Educators need not become brain researchers, but they should become familiar with what has been done in order to consider educational problems, to build on experiences, to take advantage of opportunities, and to explore the potential within the framework of what is known about the specialization and interaction of the two halves of the brain. Until scientific research has replicated the findings concerning the split brain, the dichotomy of the brain's functions (visual-verbal, creative-analytic, and lateral-linear) will be considered theory, judgment, and speculation. New bases for learning have been exposed, but only through the combined efforts of intuitive educators and scientific researchers will opportunities for learning arise.

It appears that the controversial split-brain theory could provide answers to some current issues in art education: that art is basic, that art is cognitive and leads to creative thinking, that aesthetic education is valid, that improvement is needed in the quality of art teaching, and that art merits an equitable place in school
curriculums. Art educators must take the first steps to provide suggestions for needed research to support art education and its importance in the educational process.

The brain is investigating itself. In synthesizing the findings of the functions of the hemispheres, the relationships between handedness and the hemispheres, and the discovery that the right hemisphere does have some verbal capacity, split-brain theory certainly has given new perspectives into such statements as: "On the other hand" and "Draw me a map."
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